MOPEDS: Motorized Objects Propelling Ethanol Drinking Subjects

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Mopeds are not subject to the same laws and jurisdiction as cars or motorcycles, including the requirement of a driver's license. We undertook this study to examine the influence of alcohol (ETOH) on moped crashes. We retrospectively reviewed adult moped injuries compared with motor vehicle crashes (MVCs) and motorcycle crashes (MCCs) from 1995 through 2006. Demographics, severity of injury, mortality, and serum ETOH levels were recorded. Data were analyzed using the Student *t* test for continuous data and the χ^2 test for proportional data. Motor vehicle crashes accounted for 7186 admissions. MCC and moped crashes numbered 973 and 113, respectively. Although not statistically significant ($P = 0.064$), moped crashes yielded the highest mortality (9.7%) compared with MCCs (8.5%) and MVCs (6.7%). An increased association of blood ETOH levels with moped crashes, however, was statistically significant ($P = 0.004$). Serum ETOH levels above 0.05 g/dL were observed in 1681 MVCs (23.4%), 241 MCCs (24.8%), and 44 moped crashes (39%). In this study, we discovered that moped crashes demonstrate a significantly higher ETOH involvement than either MVCs or MCCs representing a previously unrecognized public safety risk.

THE POTENTIAL INFLUENCE of alcohol intoxication on trauma, including homicide, assault, and motor vehicle collisions, has been well documented. In the 1997 National Highway Traffic Safety Administration's (NHTSA) *Current Research in Alcohol*, it was estimated that half of all trauma admissions to U.S. hospitals involved patients who were injured while under the influence of alcohol.[1] Specifically in 2007, the NHTSA reported that 32 per cent of all motor vehicle collision fatalities, 12,998 deaths, were the result of alcohol-intoxicated drivers with a blood alcohol concentration (BAC) of 0.08 g/dL or higher.[2] The percentage of alcohol-related injuries specific to motorcycle collisions has also been documented. Soderstrom and colleagues[3] reported in 1993 that 53 per cent of injured motorcycle drivers exhibited positive BAC.

Recently, we identified another group of intoxicated drivers that have yet to be studied: moped drivers. Mopeds are a class of motorized vehicles with a defined engine capacity of less than 50 cm^3 that may not exceed a speed of 30 miles per hour. Moped operator requirements and licensing laws currently vary among the states. Furthermore, in many states, an individual can legally obtain a moped license even if his or her driver's license has been previously suspended or revoked. For this reason, these drivers represent a substantial potential public safety risk. We undertook this study to assess the association between moped collisions and drivers' positive serum ethanol levels compared with automobile and motorcycle collisions.

Methods

We retrospectively reviewed the records of patients injured by motor vehicle collisions from 1995 to 2006 as identified by the Carolinas Medical Center trauma registry database. Carolinas Medical Center is a regional Level I trauma center serving an area of 6147 square miles and a population of over three million residents of North Carolina and South Carolina. Data collection included patient demographics, Injury Severity Score (ISS), mortality rates, and serum ethanol levels of all patients admitted to the trauma service after motor vehicle collisions. These collisions were categorized as automobile, motorcycle, or moped. Blood alcohol concentration testing was measured at the time of presentation for all persons involved in motor vehicle crashes in conjunction with North Carolina state law. For this study, a positive serum ethanol test was defined as

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BAC greater than 0.05 g/dL. Data were analyzed using the Student t test for continuous data and the χ^2 test for proportional data. Results were considered significant at $P < 0.05$.

Results

From 1995 through 2006, there were 8272 admissions for injuries caused by motor vehicle collisions. Motor vehicle crashes involving automobiles or trucks (MVCs) accounted for 7186 admissions (87%), and motorcycle crashes (MCCs) and moped crashes (MOPED) numbered 973 (12%) and 113 (1%), respectively (Fig. 1). As expected, the mean ISS was slightly lower for MVCs (13.7) compared with MCCs (16.3) and MOPED (15.8). However, these differences were not statistically different. Mortality among the groups was also similar with 6.7 per cent MVCs, 8.5 per cent MCCs, and 9.7 per cent MOPED. Interestingly, alcohol intoxication rates, defined as serum ethyl alcohol levels greater than 0.05 g/dL, varied significantly among the groups. Although 23.4 per cent of automobile/truck operators and 24.5 per cent of motorcycle operators were intoxicated, 39 per cent of moped operators were intoxicated ($P = 0.0004$) (Table 1).

We further compared the motorcycle and moped groups. Although both groups exhibited similar Glasgow Coma Scale scores, hospital length of stay, and intensive care unit length of stay, significant differences were observed with respect to age and BAC. Moped riders were significantly older (45 ± 14 years) than their motorcycle counterparts (37 ± 12 years). A subanalysis of intoxicated riders demonstrated a significantly higher BAC in the moped group (0.185 ± 0.096 g/dL) compared with the motorcycle group (0.122 ± 0.090 g/dL) (Table 2).

Discussion

The relationship between alcohol use, injuries, and fatalities after motor vehicle collisions has been well documented.[1–6] Many laws have been enacted to protect drivers and pedestrians from intoxicated motor vehicle operators, including convictions for driving under the influence (DUI) with BAC of greater than 0.08 g/dL, license suspension, and eventual license revocation for repeat offenders. These laws, however, seldom apply to moped operators. In many states, an individual can legally obtain a moped license irrespective of the status of his or her driver's license. Some states do not require a license at all. As such, repeat offenders whose drivers' licenses have been suspended or revoked can continue to operate these motorized vehicles.

In 2006, the NHTSA demonstrated that drivers with a BAC greater than 0.08 g/dL involved in a fatal collision were eight times more likely to have incurred a previous DUI conviction than nonimpaired drivers.[2] Our study demonstrates that moped collisions involve a significantly higher percentage of alcohol use than either automobile or motorcycle collisions. As such, we have identified a significant public safety issue. Our current laws likely allow previous offenders who are prone to recidivism to continue operating motorized vehicles in the form of mopeds because they offer a viable mode of transportation with fewer regulations.

In this study, we identified a somewhat surprising trend of increased mortality among the moped drivers (9.7%) compared with motorcycle drivers (8.5%). At first, one would expect fewer severe injuries and,

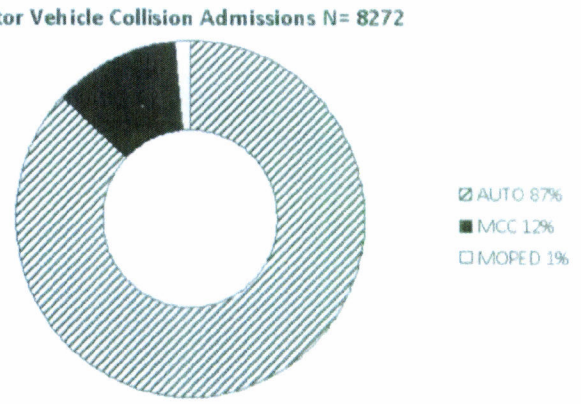

FIG. 1. Motor vehicle collision admissions, 1995 to 2006. Auto, automobile/truck crash. MCC, motor cycle crash. MOPED, moped crash.

TABLE 1. *Comparison of Injury Severity, Mortality, and Alcohol Intoxication by Category of Collision*

	Automobile	Motorcycle	Moped	*P* Value
Injury Severity Score	13.7	16.3	15.8	
Mortality	6.7%	8.5%	9.7%	0.064
Alcohol intoxication	23.4%	24.8%	39%	0.0004*

* $P < 0.05$ comparing automobile and motorcycle with moped.

TABLE 2. *Comparison between Moped and Motorcycle Drivers*

	Motorcycle Mean (SD)	Moped Mean (SD)	*P* Value
Age	37 (12)	45 (14)	<0.001*
GCS	12 (5)	12 (5)	0.47
HLOS	10 (12)	12 (17)	0.13
ICU LOS	6 (8)	6 (9)	0.40
BAC	0.122 (0.090)	0.185 (0.096)	<0.001*

* $P < 0.05$ comparing motorcycle with moped.

GCS, Glasgow Coma Scale score; HLOS, hospital length of stay; ICU LOS, intensive care unit length of stay; BAC, blood alcohol concentration (g/dL).

therefore, decreased mortality in the moped group because, by definition, these vehicles cannot achieve speeds greater than 30 miles per hour. Although the ISS was similar between groups, the moped group was significantly older than the motorcycle group. Furthermore, when the effects of alcohol are introduced, many plausible explanations arise. It is well documented that alcohol use is associated with decreased inhibitions and, subsequently, many other risk factors for injury.[7] Prior studies have shown that intoxicated motorcyclists are much less likely to wear helmets than sober riders.[8, 9] Furthermore, House and colleagues[10] demonstrated that intoxicated drivers are more likely to drive at higher speeds and in more hazardous circumstances than sober drivers. These findings, in combination with the impaired psychomotor effects of alcohol, could certainly account for the trend toward increased mortality in this population.

Although DUI laws have become more stringent, some authors estimate that only three to five arrests are actually made for every 1000 DUI episodes.[11] Of great concern is that for those who are ultimately arrested and convicted, mopeds offer an alternative mode of transportation with fewer restrictions and regulations. Furthermore, the BAC of moped drivers is significantly higher than motorcycle drivers. The ability to remain conscious with a BAC approaching 0.200 g/dL implies prior development of high alcohol tolerance, dependency, and likely recidivism.[12] Because there are currently no laws in effect to prevent potential recidivists from operating mopeds, they will likely continue to do so until either severe injury or behavior modification occurs. Similar to Li and colleagues,[7] we reiterate that drinking behavior persists across activity domains. The association, therefore, is less likely to be a causal relationship and is more likely the result of behavior patterns.

As in any clinical study, our study has several limitations. First, this is a single-institutional study that has not been subjected to multi-institutional analysis. Second, we acknowledge potential deficiencies in any trauma registry database. We recognize that data entry is subject to human error and potential omissions. It is also possible that the BACs recorded in our registry may actually be lower than the BACs at the time of injury. We recognize that potential delays, particularly for patients transferred from regional facilities, allow more time for metabolism and, subsequently, may yield lower BACs. Furthermore, in this retrospective study, we have no way to verify that every patient underwent BAC testing at the time of arrival. At present, we do not have license suspension or revocation data on the moped drivers identified in this study.

Conclusion

In this study, we discovered a greater association between moped collisions and positive serum ethanol levels compared with automobile and motorcycle collisions. Although we strongly suspect that many of these riders are drunk driving recidivists, we do not have license suspension data. The next step in studying this public health issue is to obtain records from the Department of Motor Vehicles to confirm the nationwide trends of DUI recidivism in moped operators. With this information, we hope to gain support in our effort to revise current moped laws and to close a potential loophole for DUI recidivists.

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